Southeast Regional Carbon Sequestration Partnership

Report Type:	Report and documentation of milestone completion
Report number :	Phase III 6.1.b
Report title:	**Install or Extend Additional Infrastructure**
Completion Date:	February 15, 2011
Report Issue Date:	August 22, 2011
DOE Award Number:	DE-FC26-05NT42590
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Work Product 6.1.b (Start 5/1/08 - Complete 1/30/11) Install or Extend Additional Infrastructure

Phase III 6.1.a:

Install Additional Infrastructure

Prepared for:
Southeast Regional Carbon Sequestration Partnership
led by Southern States Energy Board

by

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August 22, 2011

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Infrastructure needs at the SECARB “early” Cranfield test are different from many other CCS sites, because this test is strongly supported by the commercial activities of site host Denbury Onshore LLC. Commercial development by Denbury provided the substantive cost-share required to make the project viable. Denbury contributions fundamental for the project included the retrofit of the former Sonat natural gas pipeline from the Jackson Dome CO_2 source to the center of Cranfield Field, construction of distributory pipelines to take CO_2 to injection wells, and construction of roads and well pads that allowed access for drilling and maintenance of injection wells. In addition, as part of the EOR operations, Denbury constructed a CO_2 separation plant to increase pressure from pipeline pressure to field pressure and support CO_2 recycle, construction of production lines to bring oil, water, CO_2 and gas to the separation plant, and worked over plugged and abandoned (P&A) wells to retrofit them as producers. Producers were used by the SECARB project as monitoring points to observe flood. Denbury’s well test facility allowed monthly quantification of the volumes of fluids produced and reinjected.

The study area is rolling and wooded and logistical consideration was important in selecting viable sites for observation wells. In order to lower costs and reduce environmental concern, our observation points were “piggybacked” on infrastructure that Denbury constructed for commercial site development. Piggybacking proved a substantive contribution in this hilly area as Denbury's development included two major creek crossings, substantive reconstruction of formerly impassable roads, developed of well pads for newly drilled wells, and enlargement of well pads for workovers. This infrastructure was used for the SECARB project in several ways:

(1) Access to production wells for fluid sampling, logging and intermittent downhole pressure measurement

(2) Access to 200-300 ft deep freshwater wells for groundwater sampling. Freshwater makeup wells were drilled on the well pad of each site where a new well was drilled

(3) Access the area for post-injection seismic and VSP survey

(4) Access to the eastern edge of the field and a shared well-pad for the detailed area study (DAS)

(5) Access and well-pad for soil gas monitoring site ”P Site”.

Infrastructure development under federal funding through SECARB was focused at the Detailed Area Study (DAS). As part of the cost of observation well drilling the DAS well pad was elongated to accommodate drilling vertical wells. Vertical

wells were required in order to deploy the complex on-casing instrument array. Additional infrastructure needed for the project included extending electric service to the DAS location and purchase of an two onsite mobile containers: the office, purchased for the project by Sandia Technologoies and the U-tube lab, purchased for the project by LBNL. We plan to ship the U-tube lab container for use at Citronelle by the Anthropologic project.

Normal Denbury operations at Cranfield use no electricity at well pads. It was necessary in order to conduct the experiments at the DAS that electricity be available and reliable. Electricity was used to operate the compressor that drove the U-tube, power the downhole and surface gages, operate the quadruple mass spectrometer, and power the satellite uplink. Sandia Technologies contracted the local power company to install poles and power lines from the nearest available two-phase power connecting the DAS site to local utilities. The research team considered using three-phase power, which would have been optimal for the compressor, however the distance and cost of installation was prohibitive. Therefore we contracted a two-phase compressor.

During the planning phases, the research team considered a number of options for site infrastructure at the DAS. The final decision was to purchase two portable office containers. One container houses the control panel for the downhole electronics including bottom hole gages surface and wellhead gages and the MicroMotion flowmeter, as well as the hardware software and infrastructure for the satellite uplink. This container in addition houses the computer and software for the ERT array. The office serves as a work area for researchers during site operations and a preparation area for geochemical samples. The second portable lab container houses the high pressure fluid sampling equipment needed to operate the U-tube control computer and the quadrupole mass spec and associated analytical equipment. A third container owned by LBNL was mobilized to control and collected data from the CASSM down-hole geophysics. These three containers were located near the power on the north edge of the well pad. A fourth container was temporary rented during the high use period for materials and equipment storage and placed near the injection well.

Figure 1. Last pole of power line supplying office container.

Figure 2. Office container with satellite disk dish in the foreground; U-tube portable lab designed and fabricated by LBNL in the mid-ground. Red and yellow frac tanks in the background are used for water management.

Initially we planned that federal funds would be used to purchase additional CO_2 compression equipment to be operated by Denbury to bring pressures higher than field pressure to assure that the million metric tone/year injection rate was attained. However, Denbury determined that the excellent injectivity at the CFU 31F-1 injector negates the need for a booster pump.

No further infrastructure development is anticipated.

Figures

Figure 1. Last pole of power line supplying office container.

Figure 2. Office container with satellite disk dish in the foreground; U-tube portable lab designed and fabricated by LBNL in the mid-ground. Red and yellow frac tanks in the background are used for water management.

Figure 3 – Map showing all wells in the Federal Offshore Waters (OCS) of the northwest Gulf of Mexico and wells in Louisiana and Mississippi State Waters.